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DASSAULT

AVIATION

DIRECTION GÉNÉRALE TECHNIQUE

Division **FALCON**

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LH

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SUBJECT : All Falcon - Dassault Aviation comments on EFVS NPRM

Ref : Docket Number FAA-2003-14449 - 35

Dear Sir or Madam,

We really appreciate the possibility given by the FAA for providing you with our comments on the NPRM regarding Enhanced Flight Vision System - EFVS.

This NPRM was issued on the Federal Register on 10-Feb-03.

Dassault Aviation comments on this NPRM are gathered on the attached document DGT-DTF/SYS/AVI 281336 - two copies.

If you have any question on these comments, please do not hesitate to contact us at the following address :

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Respectfully submitted,


L. HUCHER


G. GARROUSTE

Att : Two copies of Dassault document DGT-DTF/SYS/AVI 281336 (2 x 6 pages)



Division **FALCON**

SUBJECT : All Falcon - Dassault Aviation comments on EFVS NPRM

OTHER ADDRESSEE(S) :

Ms.	✓ RODRIGUEZ	FAA ANM-116	Renton	(ENCL.)
	✓ DUNFORD	FAA	Renton	(ENCL.)
	✓ GENDRON	FAA-AEG	Renton	(ENCL.)
	✓ MORALES	SFACT/N	Paris	(ENCL.)

Comments on NPRM regarding EFVS**A – Takeoff minimums****Current rule**

§91.175 Takeoff and landing under IFR

(f) Civil airport takeoff minimums. Unless otherwise authorized by the Administrator, no pilot operating an aircraft under parts 121, 125, 129 or 135 of this chapter may take off from a civil airport under IFR unless weather conditions are at or above the weather minimum for IFR takeoff prescribed for that airport under part 97 of this chapter. If takeoff minimums are not prescribed under part 97 of this chapter for a particular airport, the following minimums apply to takeoffs under IFR for aircraft operating under those parts:

- (1) For aircraft, other than helicopters, having two engines or less – 1 statute mile visibility.
- (2) For aircraft having more than two engines – ½ statute mile visibility
- (3) For helicopters – ½ statute mile visibility

Issue

No change has been proposed to this rule with the introduction of EFVS. EFVS increases dramatically situational awareness on the ground. In case of some specific fog, the pilot can have a clear vision of the environment through EFVS though having almost no visibility with normal vision. Benefits should be given to EFVS equipped aircraft to perform takeoff using credit of enhanced flight visibility over flight visibility, provided the aircraft is equipped with a HUD system certified for takeoff guidance. This would require the introduction of the enhanced ground visibility notion which would be the average forward horizontal distance, from the cockpit of an aircraft on the ground, at which prominent topographical objects or buildings may be clearly distinguished and identified by day or night by a pilot using an EFVS.

Proposed change

§1.1 General definition

Enhanced ground visibility - the average forward horizontal distance, from the cockpit of an aircraft on the ground, at which prominent topographical objects or buildings may be clearly distinguished and identified by day or night by a pilot using an EFVS

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- (1) For aircraft, other than helicopters, having two engines or less – 1 statute mile visibility.
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- (3) For helicopters – ½ statute mile visibility

- (n) Civil airport takeoff minimums using enhanced flight vision system (EFVS). No pilot operating an aircraft under parts 121, 125, 129 or 135 of this chapter may take off from a civil airport under IFR unless –
- (1) The weather ceiling conditions is at or above the weather ceiling minimum prescribed under part 97 of this chapter; and
 - (2) The aircraft is equipped with a certified HUD system for takeoff guidance; and
 - (3) The pilot determines that the enhanced ground visibility observed by use of a certified enhanced flight vision system is not less than the minimum visibility prescribed for IFR takeoff for that airport under part 97
 - (4) If takeoff minimums are not prescribed under part 97 of this chapter for a particular airport, the following minimums apply to takeoffs under IFR for aircraft operating under those parts:
 - (i) For aircraft, other than helicopters, having two engines or less – 1 statute mile enhanced ground visibility.
 - (ii) For aircraft having more than two engines – ½ statute mile enhanced ground visibility
 - (iii) For helicopters – ½ statute mile enhanced ground visibility

B – Part 135 IFR takeoff limitations

Current rule

§135.217 IFR: Take off limitations.

No person may takeoff an aircraft under IFR from an airport where weather conditions are at or above takeoff minimums but are below authorized IFR landing minimums unless there is an alternate airport within 1 hour's flying time (at normal cruising speed, in still air) of the airport of departure.

Issue

No credit is given in this paragraph to aircraft equipped with EFVS. Flight and ground visibility might not be adequate but enhance flight and ground visibility can provide means for a safe departure. This is mostly true in case of heavy fog. It is proposed to take into account aircraft equipped with EFVS in this paragraph.

Proposed change

§135.217 IFR: Take off limitations.

No person may takeoff an aircraft under IFR from an airport where weather conditions are at or above takeoff minimums but are below authorized IFR landing minimums unless-

- (1) There is an alternate airport within 1 hour's flying time (at normal cruising speed, in still air) of the airport of departure; or
- (2) The ceiling is at or above the authorized landing minimums and the pilot determines that the enhanced ground visibility observed by use of a certified enhanced flight vision system is not less than the visibility of the IFR landing minimums

C – Equipment Definition

Current FAA proposal

No rule under part 91 subpart C nor under part 135 subpart C, regarding the EFVS equipment. No TSO governs EFVS equipment. The only mention in the NPRM is:

91.175 Takeoff and landing under IFR

(1) Approach to straight-in landing may land that approach operations below DA, DH or MDA using an enhanced flight vision system (EFVS)...

(7) The aircraft is equipped with, and the pilot uses, an enhanced flight vision system, the display of which is suitable for maneuvering the aircraft and is either an FAA type design approval or, for a foreign-registered aircraft, the EFVS is of a type design approved by the United States and complies with all of the requirements of this chapter that would be applicable to that aircraft were it registered in the United States, including the requirements for a U.S. standard air worthiness certificate.

Issue

This proposed rulemaking does not clearly define equipment requirement and seem to introduce discrimination towards non-US manufacturers. There is no proposed rulemaking regarding EFVS in Subpart C of part 91. It seems necessary to clarify EFVS requirements. As a prerequisite, a TSO should be established defining clearly the design requirements for enhanced flight vision sensors or equipment, excluding the HUD. This TSO should focus on the Infra Red, light intensification and millimeter wave systems. In addition, some operational requirements appear to be necessary in order to be consistent with current regulation and the proposed rulemaking.

Proposed change

Any approach using EFVS will de facto be equivalent to a CAT2+ type of approach, as there is no more flight visibility requirements and EFVS can be used down to 100ft. Currently, HUD systems going beyond CAT2 (i.e. CAT3a) are DO-178B level A software systems and have to follow some very strict design rules. In order to be consistent with current rules and to ensure a correct level of safety, approaches conducted with EFVS systems should offer a sufficient safety level and architecture compatible with current CAT2 rules. Therefore, we feel that EFVS operations should be conducted provided that:

- 1) the aircraft is equipped with at least 2 DO-178B Level B qualified ILS receivers, with comparison monitors.
- 2) ILS or MLS ground transmitters used during an EFVS approach should comply with CAT2 safety level
- 3) EFVS sensor imaging process should ensure that no picture lockup can happen. EFVS sensor image processing software should be at least DO-178B level C qualified.

D – Transition at 100ft

Issue

The proposed rulemaking states :

“91.175(l) (4) At 100ft above touchdown zone elevation of the runway of intended landing and below that altitude, the flight visibility must be sufficient for the following to be distinctly visible and identifiable to the pilot without reliance on the enhanced flight vision system to continue a landing:

- (i) The lights or markings of the threshold; or
- (ii) The lights or markings of the touchdown zone;”

Based on the fact that in such a situation, the pilot is conducting an approach using a HUD displaying an image coming from the EFVS, it seems very unclear how the pilot can transition from “an enhanced flight visibility... not less than the visibility prescribed” as mentioned in paragraph 91.175(l) (2) to a flight visibility as described above if the picture of the EFVS system remains displayed on the HUD. The pilot won't be able to make a correct judgment the real vision will be overlaid by enhanced vision. We feel that pilots may use the EFVS system below minimums and continue an approach using only enhanced flight vision just because they won't be able to assess flight visibility at 100ft.

Proposed change

One of the following provisions should exist with an EFVS system:

- 1) The picture of the EFVS system should be automatically removed from the HUD system shortly before reaching 100ft above touchdown zone elevation of the runway of intended landing so the pilot can determine flight visibility and make a good decision. The picture could be restored once the aircraft is on the ground or once a go-around has been initiated.; or
- 2) The pilot should have readily accessible a toggle control that would let him turn the EFVS picture ON or OFF from the HUD at will, so he can turn the system off at 100ft to evaluate flight visibility.

E – Installation requirements

Issue

There is no requirement in paragraph 91.175 (m) regarding installation of an EFVS sensor. It is of the utmost importance for such a system to provide a conformal display with the outside scenery. No or very little parallax error should be allowed, as it is currently the case with HUD systems.

Proposed change

Add a requirement on EFVS installation stating that the EFVS imaging should be within 4 mrad (milliradians) of the theoretical perfect alignment with the aircraft reference axis/Eye Reference Point.

F - Definition of Enhanced Flight Visibility

Issue

In the NPRM, there is no exact proposed wording to define the enhanced flight visibility. In the discussion of the proposal, it states that "The FAA would define "enhanced flight visibility" as the average forward horizontal distance, from the cockpit of an aircraft in flight, at which prominent topographical objects may be clearly distinguished and identified by day or night by a pilot using an EFVS".

Today, the definition of "flight visibility" is: the average forward horizontal distance, from the cockpit of an aircraft in flight, at which prominent unlighted objects may be seen and identified by day and prominent lighted objects may be seen and identified by night.

The notion of "topographical" object, which is not existing in the "flight visibility" notion, has been introduced in the "enhanced flight visibility" notion. The issue is that a pilot who has clearly identified a runway using only the runway lights with an EFVS at DH or MDA would have to go around if no topographical object is identified with EFVS because of heavy rain washout or snow storm for instance. However, the runway lights are identified with the EFVS and a safe approach could be continued. Credit should be given if the runway is clearly identified but if no topographical object is identified.

Proposed change

Define "enhanced flight visibility" as the average forward horizontal distance, from the cockpit of an aircraft in flight, at which prominent topographical objects or the runway of intended landing may be clearly distinguished and identified by day or night by a pilot using an EFVS.

G – Crew Training – EVS simulation

Due to the specifics of interpreting an IR image, we feel that crew training will be an important issue and needs to be carefully addressed. Specific models need to be defined, as they exist for HUD CAT3 qualifications. Typical and worse case situations must be defined for simulator use (such as windshear, crosswind, different types of visibility obstructions, etc...) in order to ensure that crew can reach an acceptable proficiency level with the system. Crew qualification should be based on performance obtained on the simulator.

H – Power supply design guidance

Issue

In case of a single failure between 200ft and 100ft (engine or generator), we can have a total loss of enhanced vision while the pilot is performing an approach and where he needs this enhanced vision the most to maintain clearance with obstacles and to maintain runway alignment. A single failure should not put the aircraft in a difficult situation.

Proposed change

The rule should specify that the EFVS design would guarantee the segregation between EFVS failures and failures affecting aircraft path control and performance (ILS and HUD should not be powered by the same electrical source as the EFVS for instance).

I – HUD definition

Issue

Capabilities of the HUD system installed in conjunction with the EFVS are unclear. All is mentioned so far is:

“ The EFVS sensor imagery would have to be presented on a HUD that is centrally located in the pilot’s primary field of view and in the pilot’s line of vision along the flight path. The imagery must be real-time, independent of the navigation solution derived from the aircraft avionics, and must be clearly displayed so that it does not adversely obscure the pilot field of view through the cockpit window. Aircraft flight symbology, such as airspeed, vertical speed, attitude, heading and altitude would have to be displayed on the HUD and be clearly visible to the pilot. The displayed sensor imagery and aircraft symbology could not adversely obstruct the pilot’s vision looking through the aircraft’s forward windshield.”

We feel that this is not sufficient.

Proposed change

The rule should specify that ILS guidance cues should be displayed also on the HUD. Also the rule is unclear whether the HUD system needs to be an independent guidance system or just provide a recopy of the aircraft head down display. For safety and redundancy reasons, since EFVS CAT1 approaches will have the equivalent of CAT2 actual weather minimums or even less, we feel that it would be a good idea to have a Head-Up and Guidance System coupled with an EFVS and not only a HUD system.

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No change has been proposed to this rule with the introduction of EFVS. EFVS increases dramatically situational awareness on the ground. In case of some specific fog, the pilot can have a clear vision of the environment through EFVS though having almost no visibility with normal vision. Benefits should be given to EFVS equipped aircraft to perform takeoff using credit of enhanced flight visibility over flight visibility, provided the aircraft is equipped with a HUD system certified for takeoff guidance. This would require the introduction of the enhanced ground visibility notion which would be the average forward horizontal distance, from the cockpit of an aircraft on the ground, at which prominent topographical objects or buildings may be clearly distinguished and identified by day or night by a pilot using an EFVS.

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Current rule

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No credit is given in this paragraph to aircraft equipped with EFVS. Flight and ground visibility might not be adequate but enhance flight and ground visibility can provide means for a safe departure. This is mostly true in case of heavy fog. It is proposed to take into account aircraft equipped with EFVS in this paragraph.

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